CONFERENCE SUMMARY

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& SNU Astronomy Students

Galaxy components: Bars

- S4G decompositions and trends with HT (Laurikainen)
- Bar properties from Galaxy Zoo (Bosma)
- Bars: high Fb (Sheth), requires cool disk (Sheth),
  - double bar from instabilities in cool inner disk (Min Du)
  - Fb independent of local density (Ann, Gwang-Ho Lee et al – not if too close)
  - Fb depends on spin parameter, different for strong & weak bars (Cervantes-Sodi)
  - inclination effects in measurement (Zou)
- Pattern speeds from Rring/Rbar (Perez)
- Bar profile depends on the age of the bar (Taehyun Kim)
- MW Bulge is a peanut bar, an “X” shows orbit turning points (Shen, Qin, ZYLi)
- Bar/Rings as manifolds “highways” (Athanassoula)
- Mass inflow reproduced by simulations (Yonghwi Kim)
- Bars not related to nuclear activity (Gwang-Ho Lee et al.)
- Nuclear ring size more from angular momentum after fall in than ILR (Zhi Li)
- HD simulations reproduce nuclear ring in NGC 1097 (Lien-Hsuan Lin)
- Age sequence of clusters in nuclear rings at low SFRs (Seo, Jang & Lee)

Galaxy Components: Spirals

- Interlocking resonances (Beckman)
- Pitch angle correlations with BH/bulge (Kennefick)
- Pattern speed:
  - models $\Omega p \sim \Omega$ (Sellwood, Wada)
    - also from age gradients (Martinez-Garcia)
    - although age gradients not seen with CMD fitting (Choi)
      - perhaps because gas and stars fall into spirals from both sides (Wada)
    - many self-excited modes each with constant Ωp
- Bar driven spirals? Qb correlates with radius of maximum A2 (Salo)
- Spirals driven by magnetic effects (Martos)
  - magnetic fields in spiral density waves (Nakamura)
- Hydrodynamical and gravitational structure in spiral arms (Renaud)
- GMAs in spiral regions with low shear (Miyamoto, Nakai, Kuno)

Galaxy components: Disks

- Thick disks (Comeron)
- M/L ratio increases for LSB galaxies (McGaugh)
- sub maximal (Martinsson, but see Bovy for MW)
- Central Vc gradient not correlate with anything obvious (Erroz-Ferrer)
- Rotating disks seen at high redshift too (Reichers, Combes)
- Red metal-rich globular clusters form with disk, blue metal-poor GC wider distribution, likely some from dwarfs and others from early disk star formation (Myung Gyoon Lee)
- Metallicity studies require Bayasian analysis of spectra; O/Fe vs Fe/H for thick and thin disk (Schonrich)
- Nuclear: low level AGNs very common, show molecular outflows (Combes)
- Ram pressure stripping clearly observed in Virgo (Chung)
- Ram pressure stripping disruptive in tidal dwarfs (R.Smith)

Evolution

- Observe trend from chaotic/clumpy/thick(?) phase to quiescent spiral phase (me ..)
- MW history? clump evolution models don't give peanut bulge or thick disk metallicity gradient (Inoue)
- Spirals scatter stars (Roskar) and heat stellar disk (Sellwood,): stellar mixing and resonance signatures
- M31 & MW collision from better proper motions (Sohn)
- Major Mergers at high redshift: extreme SFR: x 1000 for MW size galaxy (Reichers)
- Normal SF galaxies at high redshift have higher SF efficiencies and molecular fractions (Combes)
- Accretion from hot corona aided by cool SN debris (Fraternali)

Milky Way

- Bar/bulge: extensive surveys compare well to models with remaining puzzles about abundances and timing of bar formation (Rich, Shen, Qin, Zhao-Yu Li)
- Nuclear Disk (assoc with bar), Central Mole. Zone (assoc with nuclear bulge), Circumnuclear Disk (assoc with nuclear cluster): gas inflows (Sungsoo Kim)
- Spirals: resolution of spiral arms (local arm branches from Perseus) & kinematics (counter rot. SFR)(Xu, JJ Li)
- Disk break (Benjamin)
- Chemical tagging of groups and blind tagging (De Silva)
- Disk scale length and mass ratio to halo (Bovy)
- Kinematic features: streams, resonance orbits (M.Smith)

Models

- Dynamical: fitting orbit densities, M2M (Gerhard)
- Fit dynamically reasonable models to velocity data (Spekkens)
- Fit velocity ellipsoids to 2D kinematics of galaxies (Westfall)
- Models using structure in action space (McMillan)

To Do…

- Our understanding of the nature of spirals is changing
  - the observations have always been difficult (messy)
  - today's simulations reveal much more complexity than original spiral theories anticipated
  - … strive for a realistic model of each spiral type including all galaxy components
  - … need more kinematic observations of stars to find bar/spiral flows and resonances

To Do…

- The evolution of galaxies is revealed in a statistical sense from deep redshift surveys
  - does the star formation process matter for galaxy evolution?
  - can we see examples of processes relevant to the Milky Way?
  - … strive for models in a cosmological context with all of the known processes
    - accretion, mergers, SF, chemical evolution, star scattering, thick/thin bulge/bar transitions, …
  - … need more observations of low mass galaxies

To Do…

- The components of thousands galaxies are well measured
  - how can we understand their origins?
    - need kinematics
    - need history (age, metallicity, …)
  - are there undiscovered correlations with each other or with environment?

How long will it take to make progress?

- Significant improvements in observations?
  - Gaia, ALMA, LAMOST are about to shake things up
  - so will the James Webb space telescope in 2018
  - so will SKA in 2022+
  - .. steady progress toward bigger instruments and telescopes during the next 10 years
- Significant improvements in simulations?
  - running more cases is the easiest way to make progress now
  - advancing the “best model” is a decade-long process
- Significant improvements in “theory”?
  - there is a steady trickle of new analyses

Your turn: Observations meet Theory

- Theoreticians: what observations would be great to have?
  - be aware of selection effects in observations, document them
  - need more observations of magnetic fields

- Observers: what theory/simulations would help clarify what you observe?
  - find a better way to model the gas (viscosity?)
    - compare codes, results differ depending on code
    - better subgrid theory needed
  - need to produce observational realism, rendering
  - need statistical samples of simulations that explore parameter space
  - want observationally testable model of SF
  - need to resolve vertical dimension of a disk galaxy
  - say what features the models attempt to fit

- Modelers:
  - would like to upload a FITS cube to an on-line modeler and get galaxy properties based on models
  - put more effort into MOND type theories


International Students' Peace Talk Concert & DMZ Tour
We aspire for a peaceful Unification
of bars, spirals, bulges, disks
July 26th
Paju city and DMZ